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Tulsa Tornado Tribune

Where People Who Know the Weather Get Their Weather

National Weather Service Tulsa, Oklahoma — Fall/Winter 2009-2010

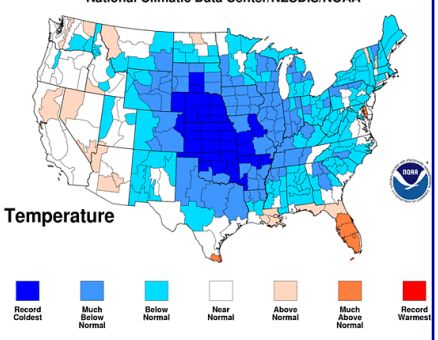
Craig Sullivan - Editor

October Surprise

An unusual month to say the least, October 2009 saw temperature and rainfall records set locally and nationally.

Record Cold

What in the world was that? Isn't October supposed to be a time of nice sunny, warm days and pleasantly cool nights? And now that we think about it, didn't this seem like one of the gloomiest fall seasons weatherwise in a long time...at least the first two months? Has our calendar gotten mixed up somehow? It sure seems that we saw a lot less sunshine than usual and the weather was unusually chilly much of the time. While the sunshine records are tough to verify, the temperature records don't lie...September and October were cold!

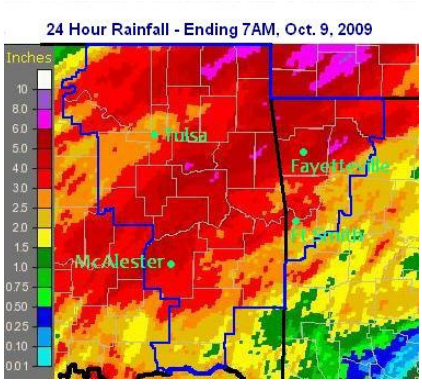


It turns out we were not alone this fall. The above map shows how climate districts across the United States departed from their average temperature from August through October of 2009. Much of the central U.S., including all of eastern Oklahoma and northwest Arkansas recorded the coldest such period on record.

The average monthly temperature at the Tulsa International Airport for October 2009 was 55.9 (6.7 degrees below normal), tying 1925 for the coldest October on record. The daily high temperatures were the primary factor in this record setting event. The observed average daily maximum temperature of 64.5 degrees was 9.5 degrees below normal, while the

Cold *Continues on page 5*

Widespread Floods



October was not only cold...it was wet; among the wettest on record in parts of Oklahoma and Arkansas, and the United States as a whole. There were only a handful of days during the month where rain did not fall somewhere within the Tulsa forecast area, but the most significant event occurred as the result of a "double whammy" of sorts, courtesy of the tropical Pacific Ocean and the Gulf of Mexico. Mid and high level moisture associated with the remains of Tropical Storm "Olaf" in the Pacific, along with deep low level moisture from the Gulf of Mexico, came together with a slow moving cold front to produce widespread heavy rainfall on the 8th and 9th.

Inside this issue:

The heavy rain led to a significant river and flash flooding event affecting most of the forecast area. Both intense rainfall rates (Porter mesonet measured 1.94" in 1 hour; Westville mesonet measured 1.90" in 1 hour; and Okmul-

Floods *Continues on page 2*

Floods

(Continued from page 1)

gee mesonet measured 2.00" in 1 hour) and prolonged steady rains were both factors in the flood event. A large portion of eastern Oklahoma and western Arkansas received 24-hour totals of 2 to 5 inches. However, some areas received considerably more, with radar estimates exceeding 7 inches across far northeast Oklahoma. The highest Co-op observer 24-hr rainfall report was 5.65" in Muskogee... the highest Oklahoma mesonet 24-hr report was 6.01" in Tahlequah.

There were numerous reports of flash flooding throughout the area due to saturated ground from earlier rains... thus, much of the precipitation ran off and quickly filled small streams. Water rescues were conducted in several locations, mostly involving people in cars. Some of the more significant flooding occurred in the town of Farmington, AR, where several people were rescued from vehicles stranded in high water, and an assisted living facility was flooded, forcing several residents to re-locate within the facility. There were also reports of several homes flooded in rural areas of eastern Carroll County.

In addition to flash flooding, there were significant rises on mainstem rivers, lasting from the 9th until the 13th. Nine of the 31 forecast points in the HSA exceeded flood stage, with 6 reaching moderate flooding. The Verdigris, Grand-Neosho, Lower Arkansas, and Lower Red River Basins all experienced flooding. The only basin in the HSA that did not experience flooding was the White River Basin in northwest AR, though the Kings River near Berryville was within a foot and a half of reaching flood stage.

Monthly rainfall totals were impressive, to say the least, with as much as 15 inches estimated over extreme southeast Oklahoma. Almost all of the forecast area received between 150 and 300 percent of the normal October precipitation, with a few areas of southeast OK and northwest AR receiving 300 to 400 percent. The Southeast Oklahoma climate division saw the second wettest October on record.

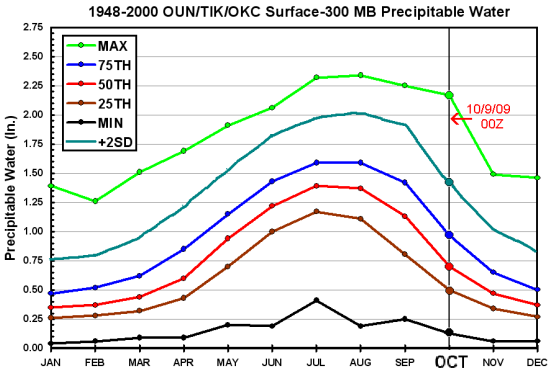
The Fort Smith monthly rainfall of 10.26 inches made October 2009 the 3rd wettest on record, and exceeded the monthly average by 6.32 inches. Rain fell on 19 days, compared to the average number of eight. Of those 19 days, 7 days saw a half inch or more, while 5 saw one inch or more. Fayetteville, AR recorded its wettest October since records began in 1949 (note: data is missing from 1982-1999) with 10.71 inches, while McAlester, OK ranked as the 4th wettest October (since 1953), and Bartlesville, OK ranked as the 6th wettest October (since 1920).

Statewide, Arkansas recorded its wettest August through October period on record, while Oklahoma ranked 6th all-time. And the pattern affected much of the country as well, as October, 2009 was the wettest on record for the United States!

What is Precipitable Water?

Defined as the amount of water in a column of the atmosphere, The Precipitable Water (PW) value can be thought of as the depth that would be achieved if all the water in that column were precipitated as rain. The total PW used in forecasting is contained in a column extending from the earth's surface, all the way to the "top" of the atmosphere.

In actual rainstorms, particularly thunderstorms, amounts of rain very often exceed the total PW of the overlying atmosphere due to air convergence bringing water vapor from a large surrounding area into the storm. Nevertheless, there is general correlation between precipitation amounts in given storms and the PW of the air masses involved in those storms...the higher the PW, the more it can rain.



When forecasting significant rain events, meteorologists often key on how the PW deviates from what is considered "normal" for a given time of year. The normal value is based on empirical observations of upper air data from sites across the United States. If PW is forecast to be way above normal, a forecaster might see this as a signal that a significant heavy rainfall event may be coming together.

The PW plot above was created using data from the Norman, OK upper air station from 1948-2005, from all available soundings during that time. Soundings were then quality controlled, with the 25th, 50th and 75th percentile values plotted. The 50th percentile represents the median value and gives a fair representation of what is "normal" for a given month. Values representing two standard deviations (SD) were also plotted, because for normal distributions (reasonable given the large sample size here), 95% of observed values lie within two standard deviations of the mean. Thus, values more than +2SD represent a pretty rare event. The Norman, OK sounding from the evening of October 8, 2009 showed a PW value of 1.91 inches...nearly 300% of the median (red), well above +2 SD (dark green), and close to the highest value ever observed in October (bright green)!

The Science of... Autumn Leaves

I will come right out and say it...fall is my favorite season. Why, you ask? Well, in addition to the end of the stifling heat and hair-curling humidity we experience for several weeks in the late spring and summer, and the beginning of football season, comes the onset of nature's stunning display as the leaves change color. And while the mention of autumn leaves conjures up images of thousands of "leaf peepers" descending on rural New England, we are fortunate enough in this area to have plenty of hardwood forest stands and rolling hills to give our region an excellent show.

Why do leaves change color in the first place? Three factors influence autumn leaf color - length of night, leaf pigments and weather.

Length of night

The timing of color change and leaf fall is primarily regulated by the calendar. None of the other environmental influences-temperature, rainfall, food supply, and so on-are as unvarying as the steadily increasing length of night during autumn. As days grow shorter, and nights grow longer and cooler, biochemical processes in the leaf begin the transformation.

Like all living organisms, all plants must eat, but they do it in a much different way than we do. In order to make food energy, in the form of glucose (a type of sugar), plants need water, carbon dioxide and energy from the sun. The plant then uses the glucose as food energy to live and grow. To capture sunlight energy, plant leaves have a green pigment called chlorophyll. This pigment is what makes plants' leaves appear green. Thus, leaves can be thought of as a plant food factory which turns sunlight into food.

Of course, it is very energetically expensive for a tree to accomplish this in the winter, when, due to lower temperatures, water transport from the ground into the tree's trunk and leaves becomes a problem. It is more energy efficient for the tree to shut down operations in the winter and go dormant. Thus, as winter approaches, the shorter and cooler days trigger trees to essentially hibernate for the winter. The leaves will not be needed for food production any longer and are shed.

Leaf pigments

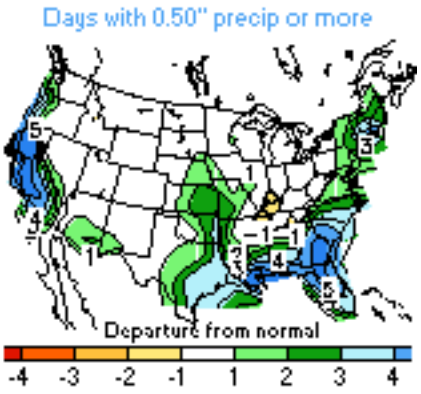
When a tree begins its preparations for dormancy, the chlorophyll (green) pigment begins to break down. But, chlorophyll is not the only pigment that a plant has at its disposal. There are other colored pigments, whose appearance is typically masked by the green chlorophyll during the growing season. The two main ones involved in leaf color change are carotenoid and anthocyanin. Carotinids are pigments that create the bright yellows and oranges that we see in some fruits and vegetables (e.g. carrots, daffodils). Anthocyanins impart a red color to plants (e.g. cranberries, cherries). When a tree stops making new chlorophyll, and the existing chlorophyll breaks down, the bright carotenoid and anthocyanin pigments are able to show through. So the fantastic array of leaf colors that we see in fall are always there, but remain hidden

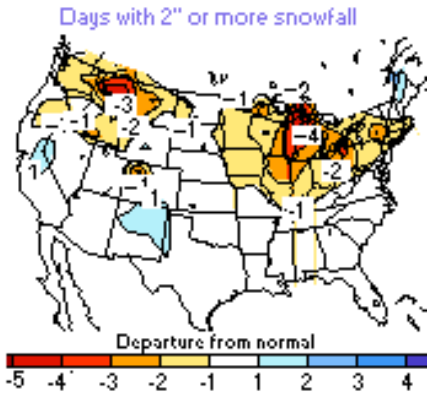
Leaves *Continues on page 6*

Does El Niño Mean More Snow?

Observations of sea surface temperature in the equatorial Pacific Ocean indicate that El Niño conditions have developed, and forecast models suggest this event will persist through the upcoming winter season. Indications also are that this will likely strengthen some during the next few months and reach moderate intensity, and could even develop into a strong El Niño before all is said and done. While the historical impacts of El Niño are more pronounced in other regions of the world, historical data does show the odds are slightly tilted in favor of above normal precipitation for eastern Oklahoma and northwest and west central Arkansas during the winter months (December through February) with moderate and strong events.

These maps show the departure from the November through March climatological normal for significant precipitation and snowfall events during moderate and strong El Niño events between 1948-2006. While there is a trend toward more heavy precipitation events (more than a half inch in a day), there is no correlation with number of days with significant snowfall.





Common Misconceptions

El Niño periods cause more disasters

Worldwide, this isn't necessarily the case. On a regional level, however, we've seen that El Niño exerts fairly consistent influences on the climate of some regions. Such conditions, combined with socioeconomic factors, can make a country or region more vulnerable to impacts.

El Niño significantly affects the climate in most regions of the globe

Only about 25% of the world's land surface is affected during any particular season, and less than 50% of land surface during the entire time that conditions persist.

El Niño episodes lead to adverse impacts only

Much of the media coverage on El Niño has focused on the more extreme and negative consequences typically associated with the phenomenon. However, El Niño events are also associated with reduced frequency of Atlantic hurricanes, warmer winter temperatures in the northern U.S., which reduce heating costs, and plentiful spring/summer rainfall in parts of Brazil, Argentina and Uruguay, which leads to above-average summer crop yields.

The stronger the El Niño, the stronger the impacts, and vice versa

Not necessarily. The important point to remember is that El Niño shifts the odds of some regions receiving less or more rainfall than they usually do, but it doesn't guarantee this will happen. For example, scientists expected the very strong El Niño of 1997/98, which triggered wildfires in Indonesia and flooding in Kenya, to also increase the chances of summer drought in India and South Africa...but this didn't happen. On the other hand, a much weaker El Niño in 2002 led to significant summer rainfall deficits.

El Niño is directly responsible for specific events

We can't pin a single event on an El Niño, just like we can't blame global climate changes for any single hurricane. El Niño can affect the frequency or strength of weather events. When looked at over the course of a season, regions experience increased or decreased rainfall, for example.

Does this mean we will see more snow and ice than usual this winter? The answer is...not necessarily, because the temperature impacts are much less clear, and may even show a slight trend toward warmer than normal winter temperatures. In general, during an El Niño winter, the storm track tends to be located more across the southern states, a big reason for the above normal precipitation...but there have also historically been less frequent intrusions of arctic air. So, unfortunately, there is no clear signal regarding snow and ice.

The official winter outlook from the Climate Prediction Center forecasts equal chances of above, below and near normal precipitation for all of the area, while the temperature outlook does indicate a slight tilt in the odds toward above normal temperatures over parts of northeast Oklahoma, with equal chances elsewhere.

Winter Products

Beginning December 8th, NWS Tulsa, along with several other offices across the nation, will begin modifying the winter weather and non-precipitation formats to produce experimental bulleted watch, warning and advisory products. The format will be similar to the format of severe thunderstorm, tornado and flash flood warnings we have been issuing for a few years now.

The experimental formats should be easier for users to read and quickly gather vital information during hazardous winter and non-precipitation events. If problems develop during the test period, we may temporarily revert back to the current format to maintain mission critical warning services.

Below are the criteria for the more common winter weather products that are issued by the National Weather Service in Tulsa.

❄**Winter Storm Warning**...Four inches or more of snow and/or significant accumulations of ice and sleet are likely.

❄**Ice Storm Warning**...ice accumulation of more than 1/4 inch are likely.

❄**Blizzard Warning**...the combination of heavy snow and strong wind of more than 35 mph will result in visibilities of less than 1/4 mile and dangerously low wind chills during the next 30 hours.

❄**Wind Chill Warning**...wind chill values colder than -20F and wind at least 10 mph are expected for 2 hours or more.

❄**Winter Weather Advisory**...a combination of snow amounts of 1 to 3 inches and light accumulations of ice or sleet will likely result in hazardous conditions in the next 30 hours.

❄**Freezing Rain Advisory**...freezing rain/drizzle with accumulations of less than 1/4 inch.

❄**Wind Chill Advisory**...wind chill values between -5F and -20F and wind at least 10 mph are expected for 2 hours or more.

❄**Freeze Warning**...can be issued in the winter season (Nov. 21 – Mar. 21) for extreme cold temperatures... e.g., temperatures of a magnitude or duration that widespread damage to water pipes is likely to occur.

Cold

(Continued from page 1)

daily average minimum of 47.2 degrees fell short by 3.9 degrees. There were 8 days in the month where the average daily temperature was at or above normal...with the remaining 23 days falling between 5 and 18 degrees below normal. This October was also the 3rd coldest on record for Fayetteville, 2nd coldest at McAlester and 2nd coldest at Bartlesville.

Interestingly, the temperature never officially dropped to freezing at the Tulsa airport in October, though it did in most of the outlying areas. The coldest temperature for the month was 35, whereas all the other years in the top 5 coldest saw temperatures below freezing at least once. It should also be noted that the temperature met or exceeded 70 degrees only 9 times in Tulsa this October... also a record for futility. On average, there are 22 days in October when Tulsa's high temperature meets or exceeds 70 degrees.

The October weather continued the trend of significantly below normal temperatures that began the last half of August. In fact, 2009 saw the coldest August through October period on record at Tulsa. The average temperature of 68.6 degrees barely edged out 1974 for the honor.

An unseasonably cold arctic airmass plunged through much of the central United States, with the cold air arriving in northeast Oklahoma early in the morning of October 9. While areas this far south and east were spared the brunt of the very cold air... freezing drizzle was reported in much of the Oklahoma panhandle on the 9th and 10th...the cool and moist airmass produced a series of days where temperatures from 15 to 20 degrees below normal over most of the area. Several daily record low maximum temperatures were set at Tulsa, Fort Smith, McAlester and Fayetteville during the period from the 9th through the 18th. Tulsa recorded its coldest 7 day period to ever occur during the first half of October, averaging around 14 degrees below normal between the 9th and the 15th.

Almost a Record

It seems the months came in the wrong order, as November was several degrees warmer than normal. The temperature at Tulsa International Airport did not officially reach the freezing mark until November 26...only two days shy of the all time latest occurrence (in 1990). Fort Smith also held off until November 26, while many other locations actually saw their first frost in October. Also, November, 2009 saw a monthly average temperature only one degree colder than October, 2009. On average, November is about 12 degrees colder than October in Tulsa.

Local News

ABRFC Staff Recognized

Tony Anderson, James Paul and Britt E. Westergard of the Arkansas-Red River Basin River Forecast Center in Tulsa were awarded the 2009 NOAA Administrators Award for the development and implementation of a new NWS River Forecast Center high resolution Gridded Flash Flood Guidance application. Congratulations to Tony, James and Britt from WFO Tulsa!

Dick Tracy Safety Day

WFO Tulsa staffed a booth at the Dick Tracy Safety Day in Pawnee, OK on October 3. In addition to the Safety Day, October 3 also marked the 50th anniversary of the flood of record at the forecast point of Black Bear Creek at Pawnee. A High Water Mark Sign was installed in town to commemorate this event and was unveiled that day.

Local Innovation

The Board of Directors of the National Association of Regulatory Utility Commissioners issued a resolution in support of the adoption and implementation of the "Sperry-Piltz Ice Accumulation Index," or "SPIA Index" by all offices of the National Weather Service across the United States that could possibly be affected by devastating ice storms, and encourages the use of the SPIA Index by disaster preparedness and emergency response agencies to better prepare for future ice storms.

The NARUC convened at its 2009 Summer Committee Meetings in Seattle, Washington, and made the resolution based on positive results from extensive testing of the SPIA Index. The most recent example occurred when WFO Tulsa was able to give advance warnings of up to seventy-two and ninety-six hours and to accurately predict footprint areas for the January 26-29, 2009, ice storm that heavily impacted parts of eastern Oklahoma and northwestern Arkansas.

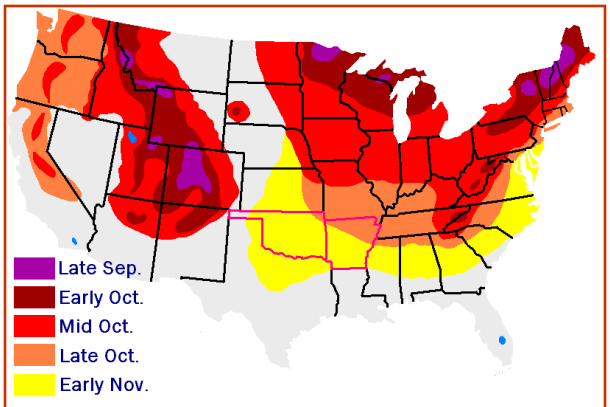
Leaves

(Continued from page 3)

until the changing season allows them to shine through.

Weather

The amount and brilliance of the colors that develop in any particular autumn season are related to weather conditions that occur before and during the time the chlorophyll in the leaves is dwindling. Temperature and moisture are the main influences.



When does peak fall color typically occur?

When the autumn days are sunny and cool, but nighttime temperatures do not freeze (usually the 35-45 degree range is best), these conditions foster a color show with more red pigments. This happens because the cool nighttime temperatures prevent the glucose (a sugar that feeds the plant) from flowing down from the leaves through the branches and trunk to be stored. Anthocyanin pigments come to the rescue to help the tree recover these nutrients before the leaves fall off, and in the process, make the leaves appear redder in color. The yellow, gold and orange colors in leaves, created by carotenoid pigment, remain fairly constant and do not change in response to weather conditions. So these fall colors don't vary as much from year to year.

The best autumn colors seem to result from this combination of seasonal patterns…

- A spring that was warm and wet
- A summer that was not too hot or dry
- A fall that had a series of warm sunny days and chilly (but not freezing) nights.

The amount of rain in a growing season can affect the autumn leaf colors, and severe droughts can delay the arrival of the fall color show for weeks. Warm, wet autumns tend to lower the intensity of fall colors. A summer with ample rainfall can enhance color, but too much rain can promote disease which compromises the plant health and reduces color. And severe early frost will kill the leaves, causing the leaves to turn brown and drop.